1,122,691

PATENT SPECIFICATION

DRAWINGS ATTACHED

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Inventor: RICHARD JOSEPH IFIELD

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COMPLETE SPECIFICATION

Fluid Seals

We, C.A.V. LIMITED, of Warple Way, Acton, London W.3., a British Company, do hereby declare the invention for which we pray that a Patent may be granted to us and the method by which it is to be performed to be particularly described in and by the following statement:—

This invention relates to fluid seals for effecting a seal between a pair of surfaces which are formed respectively on a pair of relatively movable parts, the two surfaces being disposed substantially at right angles to each other.

The object of the invention is to provide such a seal in a simple and convenient form.

A fluid seal of the kind specified comprises in combination, a member formed from a resilient synthetic resin material and having a triangular cross-section so as to define a pair of sealing surfaces which are disposed substantially at right angles to each other, the member in use, being mounted on one of said parts so that said sealing surfaces respectively are in contact with the surfaces of the parts and resilient means acting on the member to urge the surfaces into contact with each other.

In the acompanying drawings:—

Figure 1 is a sectional elevation of a liquid fuel injection nozzle employing one example of a fluid seal in accordance with the invention.

Figure 2 is an enlarged view of the seal shown in Figure 1,

Figure 3 is a cut away view of an hydraulic pump employing two further examples of a fluid seal in accordance with the invention,

Figures 4 and 5 are enlarged views of the seals shown in Figure 3,

Figure 6 is a view of a modified form of the seal shown in Figure 5, and

Figure 7 shows a view of a modified portion of the nozzle of Figure 1.

Referring to Figures 1 and 2 of the drawings there is provided a nozzle body 10 of tubular form and which at one end is provided with a nozzle head 11 having apertures 12 formed therein and through which liquid fuel can flow in use, to a combustion chamber of an engine with which the nozzle is associated. At its other end the body 10 is secured within a stepped bore formed in a substantially cylindrical support member 13 and which is formed integrally with a radial extension 14.

The bore in the support member defines a step against which a bearing plate 15 is located and the plate 15 is held in contact with the step by means of a hollow cap 16 which is in screw thread engagement with the bore. The bearing plate is provided with a centrally disposed aperture the side of which defines a bearing surface for a rod like valve member 17. The valve member extends into the chamber defined within the cap and this end of the member is of hemi-spherical form. Bearing upon this end of the member is a spring abutment plate 18 this being provided with a depression in its face which contacts the valve member, the shape of the depression being complementary to the shape of the end of the valve member. A further abutment plate 19 is provided within the cap and this is supported upon a hemi-spherical surface formed on a spigot 20 which is secured to the cap. Furthermore, intermediate the two abutment plates is a coiled compression spring 21 which acts to urge the valve member 17 towards the nozzle head 11. The end portion of the valve member remote from the abutment plate 18 is of reduced diameter and the end of the valve member is shaped for co-operation with a seating formed in the nozzle head. The member extends with clearance within the body 10 and fuel under pressure can be admitted into the annular space defined between the body and the valve member by way of an inlet passage 22 defined within the extension 14. When this occurs the fuel pressure acting on the step of the stepped portion of the valve member will move the valve member in oppositon to the action of the spring 21 and fuel will be allowed to flow through the orifice 12. In order to en-

[*Price 4s. 6d.*]

sure that the valve member will move as described the pressure within the chamber defined by the cap must be lower than the pressure of fuel which is supplied through the inlet passage 22. For this purpose a seal is provided between the valve member and the bearing plate 15.

As shown more clearly in Figure 2 the bearing plate is recessed to define a surface 23 which is substantially at right angles to the longitudinal axis of the member 17. The member at this point is of plain cylindrical form and defines a further surface. Within the recess formed in the bearing plate is an annular sealing ring 24 which is formed from resilent synthetic resin material and which is triangular in form. The seal defines a pair of sealing surfaces which are disposed substantially at right angles to each other. The sealing surfaces are held in engagement with the aforesaid surfaces respectively by means of pressure plate 25. This plate has a portion which bears against the third side of the sealing ring and a further portion which serves as an abutment for a coiled compression spring 26. As shown the third side of the sealing ring is disposed at 45° to the other two sides which constitute the sealing surfaces respectively. In use, the sealing ring prevents fuel under pressure flowing into the chamber defined within the cap and therefore the valve member can move as described.

The amount of fuel which flows past the sealing ring whilst the nozzle is in use is negligable since it will be realized that the pressure of fuel also acts to press the sealing surfaces of the ring into cntact with the aforesaid surfaces. If any quantity of fuel does leak then the gradual rise in pressure within the chamber would impair the operation of the nozzle. This may be guarded against by providing an aperture 27 in the cap 16. Alternatively and as shown in Figure 7 the valve member 17 may be provided with an axial bore 28 which communicates with a point intermediate the seating and the orifice 12. The bore 28 is provided with a non-return valve 29 to permit the escape of fuel from the chamber and to prevent the passage of fuel in the reverse direction.

Referring to Figure 3 of the drawings there is provided a hollow pump casing 40 in which is mounted a rotary cylinder block 41 which is supported about a spigot. One end face of the cylinder block is urged into contact with an end face of the casing by a coiled compression spring 43 mounted about the spigot. Within the cylinder block is formed a plurality of cylinder bores 44 each of which is provided with a port 45 which breaks onto said end face of the block. The ports 45 are arranged to register in turn as the block is rotated, with an inlet and an outlet defined in the end face of the casing.

Also provided within the casing is a rotary member 47 which is supported by bearings 49 and 50. The member 47 is coupled to an input shaft 46 whereby it can be driven, and the axes of rotation of the member and the cylinder block are inclined relative to each other. The member 47 is coupled to the cylinder block by a coupling 48 which at its ends is provided with universal joint connections. Within the rotary member 47 is provided a plurality of axial bores 51 equal in number to the number of cylinders 44 in the cylinder block. Furthermore, the relative disposition of the bores 51 in the rotary member 47, corresponds to the cylinders in the cylinder block.

Within the cylinders 44 are located pistons respectively which each comprise a head portion 52 and a stem portion 53. The stem portions of the pistons define sockets respectively which embrace balls formed on cylindrical members 54 mounted within the bores 51 respectively. Moreover, each cylindrical member 54 carries a cylindrical annular pad 55 which in use, bears against an annular fixed thrust ring 56 mounted within the casing. The faces of the pads 55 which are presented to the thrust ring are each recessed to define a pocket which is arranged to be in communication with the respective cylinder 44 by way of co-operating passages formed in the cylindrical members 54 and stem portions 53.

The pads 55 are slidably mounted within the bores 51 and can move relative to the associated member 54. The area of the surface of the pocket of each pad is so chosen in relation to the area of the surface of the pad remote from the thrust plate that fluid pressure will cause the pad to be pressed into contact with the thrust plate. Moreover, the area of the end of the cylindrical members is so chosen that the axial thrust imposed on the members when the pump is in use will be substantially balanced with the result that little or no axial thrust will be imparted to the rotary member 47 when the pump is in use. In operation, as the shaft 46 is rotated the pistons will be reciprocated within their bores and fluid will be drawn in and expelled from the ports 45 as the latter registers with the inlet and outlet respectively.

In order to provide a seal between the pads and the bores 51 and between the piston heads 52 and the cylinders 44 fluid seals in accordance with the invention are used. The seal between the pads and the bores 51 is shown in Figure 4 to an enlarged scale and it can be considered to be the reverse of the seal shown in Figure 2. As shown an annular sealing ring 58 is provided of triangular section and defining a pair of sealing surfaces which are disposed substantially at right angles to each other and which co-operate with the surfaces of the bore 51 and the pad. The surfaces are held in engagement by a pressure plate 59 which is urged against the third side of the ring by a coiled spring 60. As in the previous example the third side is disposed at 45°

to the other two sides which define the sealing surfaces respectively.

The seal between the piston head 52 and the bore 44 is shown to enlarged scale in Figure 5. As in the previous example a sealing ring 65 is provided of annular form and having a triangular section. The sealing ring defines a pair of sealing surfaces which are urged against the surface of the bore 44 and a surface defined on the piston head 52, by a pressure plate in the form of an annular ring 66 which is loaded by an annular dished spring 67 the outer periphery of which bears against the pressure plate, and the inner periphery of which is retained by the resilience of the spring against a step defined on a spigot member 68 upstanding from the piston head.

In a modification of the last arrangement and as shown in Figure 6 the pressure plate as a separate item is omitted and the spring 69 is modified so as to act both as a spring and a pressure plate. The spring comprises an annular ring 69 having radial slots extending inwardly from the external periphery so as to define tongues 69*a* which when the spring is assembled behind the step on the spigot define a plurality of pressure plates which bear against the sealing member to retain it in position.

Although a pump has been described the same arrangement can be used as a motor providing that fluid under pressure is supplied to the inlet.

The seals described have been used for sealing between two parts one of which has a cylindrical surface and where the relative movement between the parts has taken place axially with respect to the cylindrical surface however, it will be understood that the seals are equally effective for sealing where angular or rotary movement occurs between the parts or where both axial and angular movement can occur at the same time.

WHAT WE CLAIM IS:—

1. A fluid seal of the kind specified comprising in combination a member formed from a resilient synthetic resin material and having a triangular cross-section so as to define a pair of sealing surfaces which are disposed substantially at right angles to each other, the member in use, being mounted on one of said parts so that said sealing surfaces respectively are in contact with the surfaces of the parts, and resilient means acting on the member to urge the surfaces into contact with each other.

2. A fluid seal as claimed in claim 1 in which the other side of the member is disposed substantially at 45° relative to the sides of the member defining said sealing surfaces.

3. A fluid seal as claimed in claim 2 in which said resilient means comprises a spring which acts on said other side through the intermediary of a pressure plate.

4. A fluid seal as claimed in any one of the preceding claims in which the seal member is of annular form.

5. A fuel injection unit comprising in combination a body of tubular form, a nozzle head formed or secured to one end of the body, and having an orifice formed therein, a seating defined in the nozzle head, a valve member extending with clearance within the body and having its end adjacent the nozzle head shaped for co-operation with said seating, resilient means acting upon the end of the valve member remote from the seating for urging the valve member into contact with said seating and thereby to prevent flow of fuel through said orifice, passage means through which fuel under pressure can flow into the space defined between the valve member and the body, thereby to cause the valve member to be moved in opposition to the resilient means so as to permit fuel to flow through said orifice, a bearing plate having an aperture formed therein and through which the valve member passes, the bearing plate defining a surface on its side which is directed towards the nozzle head and the valve member defining a further surface which is disposed substantially at right angles relative to the first surface, a sealing member of annular form surrounding the valve member and having a triangular cross-section, said sealing member defining a pair of sealing surfaces which are disposed substantially at right angles relative to each other, the sealing member being formed from a resilient synthetic resin material, and means acting against the member to urge the sealing surfaces and said surfaces into sealing engagement respectively.

6. A nozzle unit as claimed in claim 5 in which the sealing surfaces are defined by two sides of the member and the third side is disposed substantially at 45° relative to the other two sides.

7. A nozzle unit as claimed in claim 6 including a pressure plate of annular form which is urged against the third side of the member by a spring.

8. A nozzle unit as claimed in claim 7 including a support member to which the body is secured and in a bore in which the bearing plate is located, a cap serving to close the open end of said bore in the support member, the cap defining a chamber in which the resilient means which acts upon the valve member is located.

9. A nozzle unit as claimed in claim 8 in which the cap is provided with a vent.

10. A nozzle unit as claimed in claim 8 in which the valve member is provided with an axial bore through which the chamber in the cap can be vented, the bore being provided with a non-return valve which allows the escape of fluid under pressure from said chamber but which prevents fluid under pressure entering said chamber through the bore.

11. A fluid pump or motor comprising in combination, a cylinder block in which is formed a cylinder, a port through which fluid

can flow into and out of the cylinder, a piston reciprocable within the cylinder, a rotary shaft, means coupling the shaft to the piston whereby rotary motion of the shaft will impart reciprocating movement to the piston and vice-versa, the piston including a head portion which defines a surface which lies substantially at right angles to the surface of the cylinder, an annular sealing member formed from resilient synthetic resin material carried by the head portion, said sealing member being of triangular cross-section and defining a pair of sealing surfaces which are disposed substantially at right angles relative to each other, and means carried by the head portion for urging the sealing surfaces into contact with said surfaces respectively thereby to prevent the escape of fluid past the piston.

12. A fluid pump or motor as claimed in claim 11 in which the sealing surfaces are defined by two sides of the member and the third side is disposed substantially at 45° relative to the other two sides.

13. A fluid pump or motor as claimed in claim 12 in which the means carried by the head comprises a pressure plate of annular form which is urged against the third side of the sealing member, by a spring.

14. A fluid pump or motor as claimed in claim 13 in which the spring is of annular dished form and has its outer periphery bearing upon the pressure plate and its inner periphery located against a step defined upon a spigot upstanding from the head portion of the piston.

15. A fluid pump or motor as claimed in claim 12 in which the means carried by the head portion comprises a spring of annular form which is provided with a plurality of slots extending inwardly from its outer periphery said slots defining tongues, the inner periphery of the spring being engaged behind a step defined upon a spigot upstanding from the head portion of the piston, and the tongues bearing upon the third side of the sealing member.

16. A fluid pump or motor as claimed in any one of claims 11, 12, 13, 14 or 15 in which the cylinder block is adapted to be rotated with the shaft, and the means coupling the shaft to the piston comprises a rotary member which is arranged to be rotated with the shaft, the axes of rotation of the member and the cylinder block being inclined relative to each other, the rotary member having formed therein an axially extending bore the longitudinal axis of which is spaced from the axis of rotation of the member, a cylindrical member mounted within the bore and having a ball formed on its end which is presented to the cylinder block, the piston having a stem portion the end of which remote from the head being provided with a cup which embraces the aforesaid ball, a thrust pad slidable within the end of the bore in the rotary member, a thrust ring against which the pad is pressed by fluid pressure from the cylinder, a sealing member of annular form and having a triangular cross-section the pad and side of the bore defining surfaces respectively which are substantially at right angles relative to each other, a pressure plate of annular form located against the third side of the sealing member and a coiled compression spring acting upon said pressure plate so as to cause the surface and sealing surfaces to be held in contact respectively.

17. A fluid seal for effecting a seal between a pair of surfaces which are formed respectively on a pair of relatively movable parts and comprising the combination and arrangement of parts substantially as described with reference to Figure 2 of the accompanying drawings.

18. A fluid seal for effecting a seal between a pair of surfaces which are formed respectively on a pair of relatively movable parts and comprising the combination and arrangement of parts substantially as described with reference to Figure 4 of the accompanying drawings.

19. A fluid seal for effecting a seal between a pair of surfaces which are formed respectively on a pair of relatively movable parts and comprising the combination and arrangement of parts substantially as described with reference to Figure 5 of the accompanying drawings.

20. A fluid seal for effecting a seal between a pair of surfaces which are formed respectively on a pair of relatively movable parts and comprising the combination and arrangement of parts substantially as described with reference to Figure 6 of the accompanying drawings.

21. A liquid fuel injection nozzle comprising the combination and arrangement of parts substantially as described with reference to Figure 1 of the accompanying drawings.

22. A liquid fuel injection nozzle comprising the combination and arrangement of parts substantially as described with reference to Figure 1 as modified by Figure 7 of the accompanying drawings.

23. A fluid pump or motor comprising the combination and arrangement of parts substantially as described with reference to Figures 3, 4 and 5 of the accompanying drawings.

24. A fluid pump or motor comprising the combination and arrangement of parts substantially as described with reference to Figure 3 as modified by Figure 6 of the accompanying drawings.

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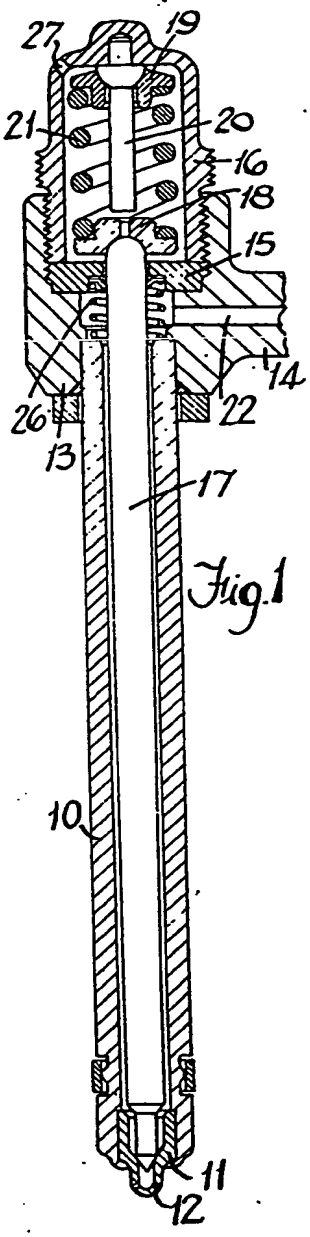


Fig. 1

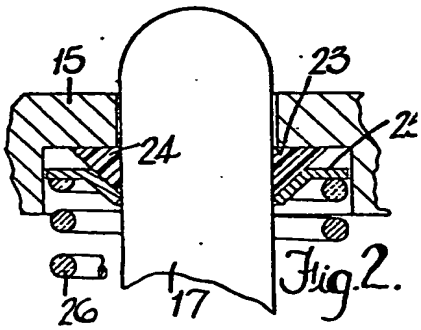


Fig. 2.

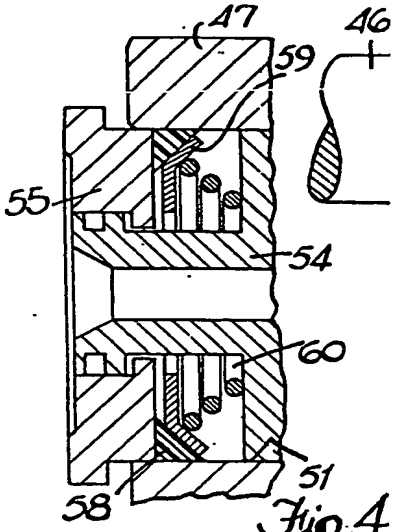
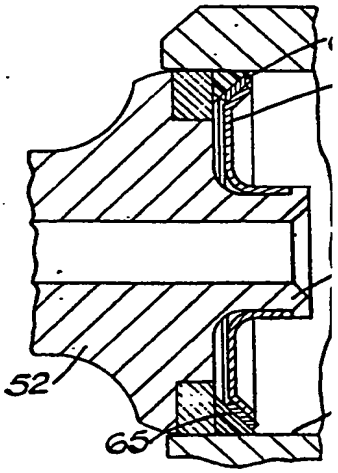


Fig. 4.



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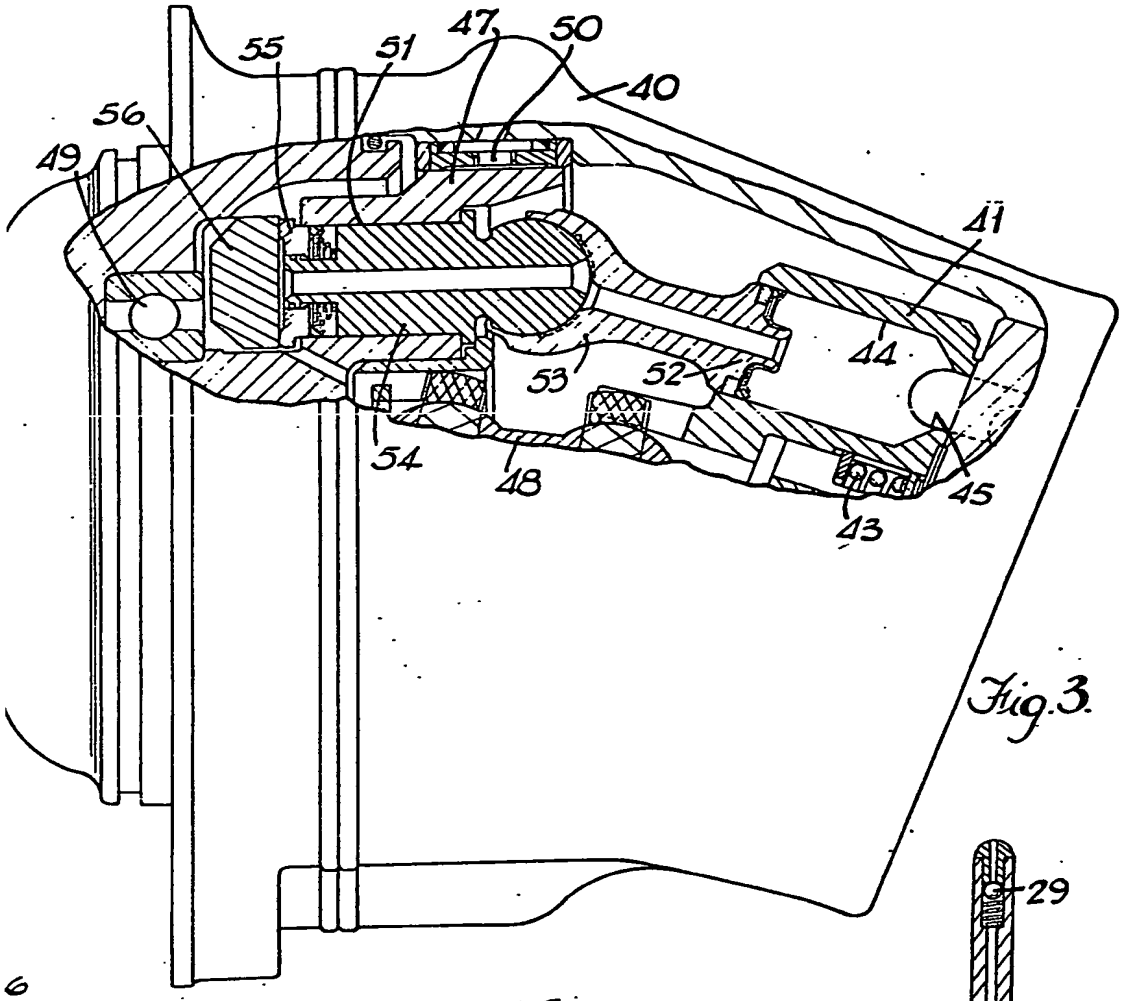

Fig.3.

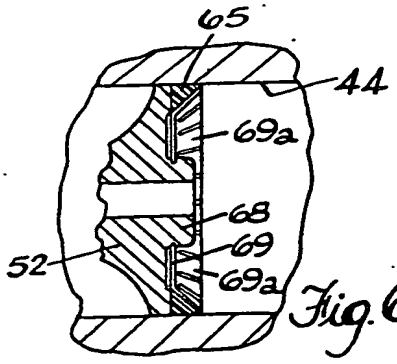

Fig.6.

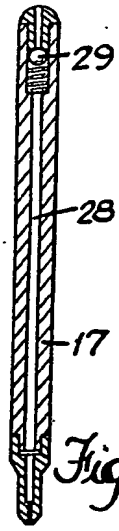

Fig.7.

Fig.5.

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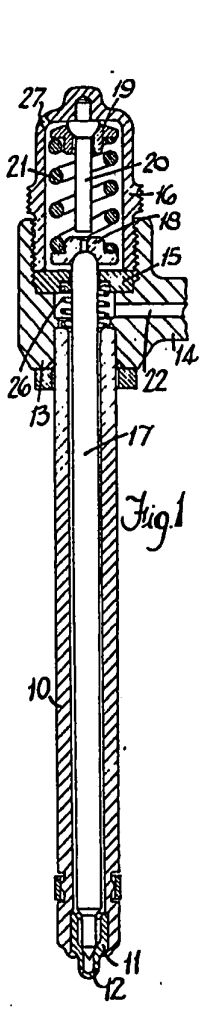

Fig.1

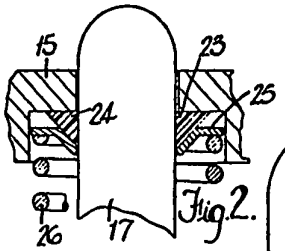

Fig.2.

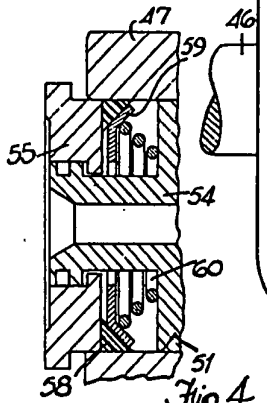

Fig.4.

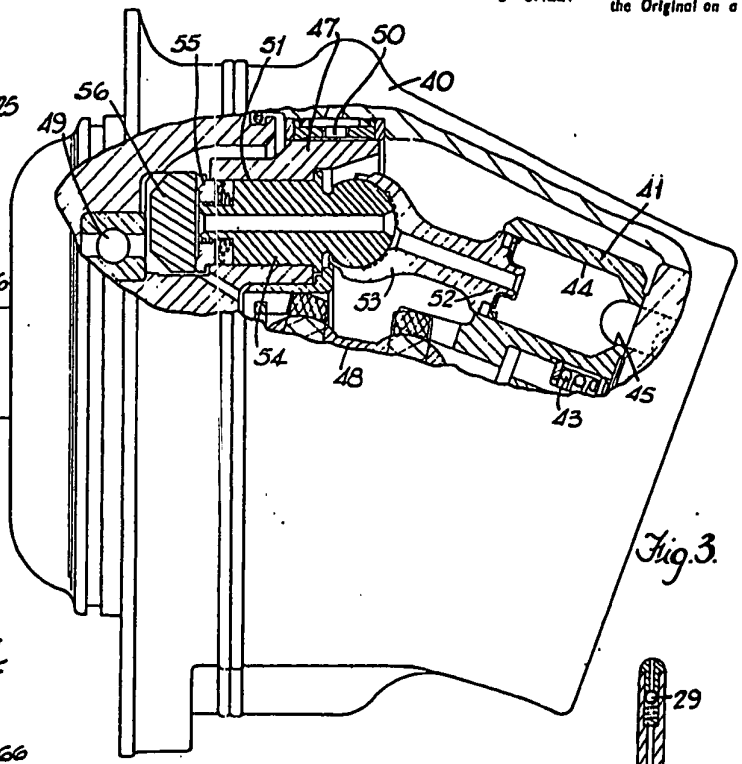

Fig.3.

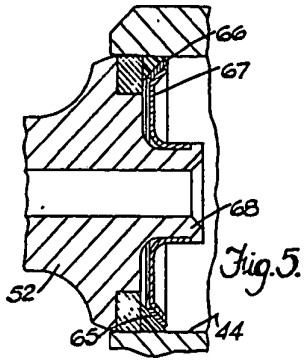

Fig.5.

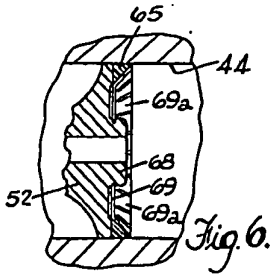

Fig.6.

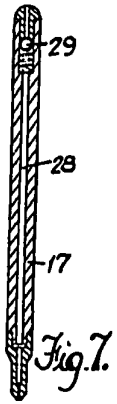

Fig.7.